BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to the field of golf clubs and specifically to an improved golf club head having one or more internal fins.

Background Art

Golf club heads that are made from a metallic material such as titanium alloy or stainless steel (metal woods) have distinct advantages over wooden club heads. Generally, wooden club heads are less durable, vary significantly in density, hardness, grain structure and require great expertise through the manufacturing process to produce similar results from club to club. Metal woods however can be replicated consistently with tolerances that in some cases surpass aerospace quality components. Improvements over the last decade in the manufacturing processes of metal woods have enabled manufacturers to design larger metal wood club heads. These larger metal woods deliver improved performance benefits over smaller metal woods in that designers are able to transfer weight to specific areas of the metal wood club head to enhance certain desired characteristics at impact, namely golf ball launch, spin and club head twist, which affect ball flight and direction. Larger metal woods outperform their smaller counterparts because more of their mass is distributed toward the perimeter of the club head therefore making them more stable at impact. The larger metal woods also exhibit less oscillation at impact with the golf ball and that provides for a more efficient energy transfer resulting in longer, straighter and more consistent shots. Because the larger metal wood club heads are bigger than their smaller counterparts, they are also easier to setup behind the golf ball thereby offering a psychological benefit to the golfer. They look easier to hit.

Over the last decade manufacturers have substantially increased the size of metal wood club heads, particularly drivers. The pace at which this has happened has been driven by several factors.

1. Golfers are always searching for ways to hit the golf ball further and straighter. Larger club heads are more stable during impact with the golf ball and are easier to hit, resulting in consistently longer and straighter hits.
2. Manufacturing methods and processes have improved allowing further development of larger metal wood club heads that have extremely thin wall structures.
3. These thin wall structures allow designers to manipulate the weight distribution in the club head to optimize the stability of the club head at impact with a golf ball.
4. The successful development and introduction of lighter and stronger high performance alloys further allows designers an opportunity to manipulate weight and impact dynamics.
5. The cost of development and manufacturing has been greatly reduced making what would have been an exotic golf club head a few years ago, an affordable purchase consideration for any serious golfers looking for performance improvement in their game.

Regardless of manufacturer, most metal wood club head weights are within a few grams of each other. Typical driver club head weights range from approximately 192 grams to 202 grams depending on the club length, shaft type and manufacture specifications. Generally, club head weights will remain constant in order to provide proper balance, physical and mechanical properties which combine to produce a well balanced, good performing golf club.

Metal wood (driver) club heads have grown in size over the last decade from approximately 200cc in volume to over 400cc in volume but at the same time remaining in the weight range of 192 grams to 202 grams. In some cases these metal wood driver club heads are becoming lighter to take advantage of the increased club head size, lighter and longer shafts and lighter grips. The overall lighter golf cub with increased length, can be swung at a higher rate of speed increasing the club head velocity as it impacts the golf ball resulting in added distance over shorter heaver metal wood golf clubs that cannot be swung as fast. As the metal wood golf cub heads become larger, the wall thickness must be reduced to achieve the desired size and still remain in the desired weight range. The larger the club head, the thinner the wall required to produce it. The materials used to produce these large club heads vary in density and strength properties. The largest metal wood driver club heads are produced by cast or forged manufacturing methods using titanium alloys. Titanium is preferred over stainless steel alloys because it is approximately 45% lighter and approaches the same strength as stainless steel. However other materials can be used, such as carbon fiber, metal matrix composites, aluminum or magnesium. When a metal wood driver comes into contact with the golf ball during the golf swing, the resultant collision, depending on the impact velocity and angle of attack of the metal wood, causes the golf ball to compress and the metal wood driver club head to deform. The amount of the deformation to the metal wood club head, particularly driver club heads, during impact with the golf ball depends on, but is not limited, to the following factors.

1. The size of the metal wood club head;
2. The material used to construct the metal wood club head;
3. The design and construction of the metal wood club head;
4. The wall thickness of the metal wood cub head;
5. The velocity of the metal wood club head as it comes into contact with the golf ball;

6. The angle of attack at which the metal wood club head impacts the golf ball;
7. The distribution of mass that makes up the metal wood club head structure;
8. The mass of the metal wood club head;
9. The center of gravity of the metal wood club head;
10. The golf ball impact point in relation to the clubhead CG;
11. The stiffness of the club metal wood club head;
12. The strength of the metal wood club head structure.

As metal wood club heads become increasingly larger, their ability to resist deformation at impact with the golf ball is reduced particularly if a material is selected that has reduced stiffness properties. Such is the case with titanium which has roughly half the stiffness than that of stainless steel. Even with the use of high performance materials like titanium or carbon fiber, the weight constraints common in most driver club heads make it imperative to design driver club heads with thinner walls.

As the club head comes into contact with the stationary golf ball during the downswing, the club head structure oscillates and deforms in an effort to move around the stationary golf ball. The golf ball compresses under the impact load with the club head initiating a lateral change in direction of the golf ball away from the golf club head center of gravity resulting in the golf ball rolling in the direction of least resistance prior to the initiation of the rebound phase of the golf ball's impact with the club head. During the impact process, the stored energy that would normally be transmitted to the golf ball from the club head is momentarily redirected to the club head. The resulting redirection of energy sends a mechanical shockwave through the club head structure causing said structure to flex and deform. This occurrence creates a loss of energy that could otherwise be imparted from the club head to the golf ball during impact. The resulting energy loss that occurs during the impact of the golf ball and the club head due

to oscillation and flexing of the club head structure, results in a reduction of energy that would normally be transferred to the ball from the rigid golf club head structure and therefore results in reduced initial velocity of the golf ball as the golf ball rebounds away from the club head.

It would be highly advantageous to improve the golf club head structure to resist structural deformation and shockwave migration so that more of the energy at impact is transmitted to the golf ball instead of being dissipated in the club head.

SUMMARY OF THE INVENTION

The present invention provides an improved golf club head wherein each club head has at least one rib/arch/fin, or a series of ribs/arches/fins, herein referred to as "fins", that form from a point of origination inside the club head structure and increase and decrease in height. The fins are located to run along the inside of the club head perimeter structure that is comprised of a crown, sole, skirt and face. The angle of the fins is perpendicular to the face resulting in stiffening and strengthening the club head thereby resisting structural deformation and mechanical shockwave migration that occurs upon impact with the golf ball.

This is accomplished by incorporating fins internally that traverse the length or a portion of the length of the club head along the perimeter radii as defined by the shape of the club head structure. The demarcation line of the radius begins and ends at the crown, sole, skirt and face transition. The fins are incorporated on either the crown and/or the sole, but can be added to other surfaces of the club head, such as the skirt, or club face should additional stiffening and strengthening be desired. The fins can vary in size and shape and location depending on the desired stiffness and strength. The fins vary in size and shape depending on the size, shape and material of the club head.

The dimensions of the fins are dependent on the shape and radius of the inner and outer structure of the club head. The fins have two dimensions that are governed by the size, shape and radius of the club head structure.

1. The height of each fin at its apex is at least the same as that of the outer club head structural radii as measured at the demarcation of surface transition points from where the radii originate inside the cub head structure.

2. The fin's height away from its apex is substantially less than its height measured at its apex.

The fins can be incorporated into the club head structure through typical manufacturing processes such as casting or forging to produce a one piece club head or they can be affixed in a secondary manufacturing process such as welding, brazing or gluing. The shape and location of the fins resist impact-caused deformation and shockwave migration, thereby reducing energy dissipation and resulting in more efficient transfer of energy into the golf ball.

BRIEF DESCRIPTION OF THE DRAWINGS

The various embodiments, features and advantages of the present invention will be understood more completely hereinafter as a result of a detailed description thereof in which reference will be made to the following drawings:

FIG. 1 is a cross-sectional side view of a golf club head in a direction parallel to the hitting surface and showing one embodiment of the inventive fins;

FIG. 2 is a cross-sectional end view of the FIG. 1 embodiment, but taken in a direction that is perpendicular to the hitting surface;

FIG. 3 is similar to FIG. 1 but illustrating the force vectors resulting in form the inventive fins;

FIG. 4 illustrates the force vectors in a conventional club head without the inventive fins;

FIGs. 5-8 illustrate cross-sectional side views showing various overall shape variations of a fin of the invention;

FIGs. 9-14 illustrate various cross-sectional end views showing shape variations of a fin of the invention; and

FIG. 15 illustrates placement of inventive fins on the inside of the hitting surface.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the accompanying drawings and initially to FIGs. 1-4, it will be seen that an improved metal wood golf club head 10 according to a preferred embodiment of the present invention, comprises a hitting surface or face 12, a sole 14, a crown 16, a skirt18, a hosel 20, a toe 22 and a heel 24. These are conventional features of a typical club head. Those features that are novel and unique to the present invention comprise fins 15, 17, 19 and 21. While the illustrated embodiment employs four such fins, (i.e., two along the interior of crown 16 and two along the interior of sole 14) it will be understood that the actual number may be other than four. Moreover, each such fin is preferably of varying height with a maximum height or apex that coincides with an imaginary surface drawn between demarcation or transition points on the intersections between different club head surfaces. By way of example, fin 15 has an apex 32 which coincides with a plane "A" defined by the intersection of crown 16 with face 12 and with skirt 18 and by the intersection of crown 16 with toe 22 and with heel 24 or hosel 20. Similarly, fin 17 has an apex 34 which coincides with a plane "B" defined by the intersection of sole 14 with face 12 and with skirt 18 and by the intersection of sole 14 with toe 22 and with heel 24. Upper fin 19 and lower fin 21 similarly have apices 36 and 38, respectively defined in the same manner.

FIGs. 3 and 4 illustrate the advantageous effect of these internal fins on forces generated by impact of the club head with a golf ball (not shown). More specifically, as shown in FIG. 3, the force generated at the force 12 upon impact, in turn, generates a rebound force at each of the fins (15, 17 for example). On the other hand, in a conventional club head 30 shown in FIG. 4, the force at the face propagates to each of the other surfaces with little attenuation causing expansion of sole 31 and crown 33 and rebounds from skirt 35 since there are no internal fins to withstand and resist propagation of the impact force as there are in the head 10 of FIG. 3.

The actual shape of the fins as well as the location of the apex along each fin can be selected to promote higher energy transfer into the golf ball while minimizing the effect on weight distribution of the head structure. By way of example, FIGs. 5-8 illustrate in cross-sectional side views a number of alternative embodiments of a fin structure. Fin 15 of FIG. 5 is that shown in FIGs. 1-3 and comprises a solid fin with a more centrally positioned apex. FIG. 6 shows a fin 23 that is open at its base to reduce weight but is otherwise the same as fin 15. Fin 25 of FIG. 7 is a solid fin but has its apex located closer to the club head face. Fin 27 of FIG. 8 is similar in shape to fin 25 of FIG. 7, but has an open base to reduce weight.

FIGs. 9-14 illustrate alternative end view cross-sections of the fins of the invention. By way of example, fin 15 of FIG. 9 has a tapered cross-section. Fin 23 of FIG. 10 has the same cross-section shape as fin 15, but with the open base shown in FIG. 6. FIG. 11 illustrates a fin 28 having an I-beam shaped cross-section with a rail 26 at the bottom surface thereof. FIG. 12 illustrates a fin 29 having a uniform or constant width cross-section. FIGs. 13 and 14 illustrate V-shaped cross-sections one of which extends from crown 16 and the other of which is formed from a groove in crown 16. Figs. 5-8 and 9-12 are intended to demonstrate numerous variations in fin shape, apex location and cross-section. However, it will be understood that these variations are only a few of innumerable possible variations each of which may provide somewhat different effects on the attenuation of the impact forces that would otherwise propagate toward the other surfaces of the club head.

FIG. 15 illustrates yet another embodiment 40 which provides either in addition to or as a substitution for the fins of FIGs. 1-3, a pair of fins 42 and 44 which are positioned on the interior of face 12 and which also contribute to attenuation of the forces generated upon impact of the face with a golf ball.

Having thus disclosed numerous illustrative embodiments of the invention, it will be understood that the novel features thereof reside fundamentally in the use of internal fin structures to improve the efficiency of force transfer from the club head to the golf ball and that the precise number, shape and location of such fins may be varied within alternative versions to achieve the desired results thereof. Accordingly, the applicant has disclosed the currently contemplated best mode of the invention with the understanding that the scope of the protection afforded hereby is to be limited only by the appended claims and their equivalents.

I claim: